UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

SO-AL

REPLY TO: 4050 Research Programs

September 24, 1980
(RWU 2203)

SUBJECT: Approved Study Plan, FS-SO-2203-1.45 (Mosrr)

TO: S. J. Barras
AD-W

Attached is the study plan summary and a copy of subject study plan entitled "Test of a technique for rearing mite-free southern pine beetle adults".

Pete

PETER L. LORIO, JR.
Project Leader
Forest Insect Research

Enclosure

PLLorio,Jr./bjm

4500
FS-SO-2203-1.45
(Problem 1b)

September 1980
Study Plan Summary
John C. Moser - Alexandria, La.

TEST OF A TECHNIQUE FOR REARING MITE-FREE SOUTHERN PINE BEETLE ADULTS

This study tests the hypothesis that bark containing southern pine beetle brood removed from naturally infested trees will dry up and thus result in emerging brood adults carrying no mites. This method, if it works, will provide a much needed tool for rearing mite-free southern pine beetle populations.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

SO-AL

REPLY TO: 1630 Publications

May 18, 1980
M(RWU 2203)

SUBJECT: Study Plan, "Developing...adults".

TO: T. Dell
RWU 1302
NOLA

Can you give me some ideas as to how I should write up the analysis section for this study plan?

JOHN C. MOSER
Research Entomologist
Forest Insect Research

Enclosure

JCMoser/bjm

4500
FS-SO-2203-1.45
(Problem 1b)

STUDY PLAN

TEST OF A TECHNIQUE FOR REARING MITE-FREE SOUTHERN PINE BEETLE ADULTS

Prepared by:

John C. Moser — Sept 2, 1980

John C. Moser
Research Entomologist

Date

Approved by:

Peter L. Lorio, Jr. — 9/22/80

Peter L. Lorio, Jr.
Project Leader
RWU-2203

Date

4500
FS-SO-2203-1.45
(Problem 1b)

STUDY PLAN

TEST OF A TECHNIQUE FOR REARING MITE-FREE SOUTHERN PINE BEETLE ADULTS

John C. Moser

INTRODUCTION

About 15 mites are commonly phoretic on the southern pine beetle (SPB) (Moser and Roton 1971, Kinn 1976), with the proportion of infested flying adults conservatively estimated at about 40% (Moser 1976).

The trophic habits of these phoretic mites vary widely from bark beetle predators to mycophagous and nematophagous to saphrophagous, or various combinations thereof. Some are detrimental to the SPB, some neutral, and some beneficial (Kinn 1967, 1977; Moser 1975). Since many of these mites play such an integral role in the life history of the beetle, it is clear that to determine the true role of the SPB in future laboratory and field experiments, phoretic mites must be excluded.

But at present, there are no effective methods for rearing large numbers of SPB without phoretic mites. Past techniques, including visual examination of emerged beetles and rearing beetles from eggs placed in artificial media, had serious drawbacks. Visual checking methods invariably injured the beetles because the elytra had to be lifed. Beetle adults reared from artificial media were somehow impaired physically or behaviorally because few succeeded in attacking freshly cut bolts.

After leaving the attacking beetle, all mites pursue various activities in the phloem in or near the beetle galleries. Kinn (1979) first documented that desiccation of the phloem accounted for the mortality of some mite species. Subsequent exploratory studies (Tables 1, 2) showed that desiccation might severely reduce or eliminate all mite populations, resulting in virtually no phoretic mites on emerging beetles. This suggested that desiccation might be used as a tool for rearing mite-free populations of SPB.

The purpose of this study is to test the hypothesis that bark containing SPB brood removed from naturally infested trees will dry up and thus result in emerging brood adults carrying no mites. Other objectives are to determine when parent adult emergence ends and when the brood adult emergence begins in bark stripped from bolts, and if seasons and tree height influence emergence.

Bolts will be numbered one through ten, and trimmed so that each will contain the bark equivalent of 2880 square centimeters (Fig. 1). The ten bolts will then be divided into 5 pairs of 2 treatments each (bolts 1 and 2 = pair 1; bolts 3 and 4 = pair 2, etc.). The bark will be removed by random selection from one of the bolts in each pair (treatment 1) and the other bolt will remain undisturbed (treatment 2) (Table 1). The 10 bolts (Fig. 1) will be placed in individual rearing cans inside the laboratory, which is kept relatively dry due to air conditioning in summer and heating in the winter. To obtain an approximate idea of the laboratory and outside humidity and temperatures, the wet bulb, dry bulb, will be recorded at noon daily both inside and outside of the rearing building from the time the bolts are cut until the beetles stop emerging (Table 5).

Bark moisture readings will be measured with a model RC-1 Delmhorst moisture detector. Readings will be made in the phloem of all 10 bolts as soon as possible after they arrive from the field. In addition, moisture readings will be recorded from the phloem of the five bolts that were stripped of their bark. Thereafter phloem moisture readings will be made daily from pair sample 3 only (Tables 1 and 2).

METHODS AND MATERIALS

Four loblolly pines (*Pinus taeda* L.) naturally infested with SPB will be selected with brood in the pupal life stage and with parent adults already emerged. The pupal stage is selected because, once the brood reach this stage they have migrated into the outer bark and are more likely to complete their development; also they have not yet become phoretically attractive to mites (Roton 1978).

It is important that the trees selected have bark at least 4 mm thick, in the sample sections. Roton (1978) showed that in thin bark (under 2 mm) larvae are forced to puapte in larval cells, whereas in thick bark (over 4 mm), larvae pupate in the mid bark. Recent exploratory studies revealed that when the bark is removed, pupal development is influenced little when pupae are protected inside their pupal cells in thick bark; but in thin bark, mortality of the exposed pupae is severe because even if they do not fall out of their open cells, they are likely to be desiccated.

Other exploratory studies have shown that some mite species are more abundant in summer and some in winter, thus necessitating sampling of infested trees by season. One infested tree will be felled on or about each of the following dates: February 1, May 1, August 1, and November 1, 1980. Ten consecutive bolts, about 50 cm in length will be taken from each tree along the bole area where pupal stages are most concentrated, and where competition from other bark beetle species is least. No attempt will be made to normalize infested bole heights within trees (McClelland et al. 1979), because the objective is not to sample tree populations systematically.

To determine the mite fauna initially on the inner bark, and how long they last, a survey of the mite species and their relative abuncance will be made using one bark sample about 1000 square centimeters stripped from bolt X3 located between bolts four and five (Fig. 1). The mite surveys and bark moisture readings will be made as soon as possible after the bolts are cut, and hourly thereafter for six hours after stripping. Subsequent readings will be taken at 12 hours, 24 hours and then daily until mites no longer are present (Table 3).

Since the 1000 square centimeters of bark in Table 3 may not encompass all of the phloem mite fauna, an initial survey will be made by examining all of the bark on the other 5 excess bolts along the length of the bole (Fig. 1, X1, 2, 4, 5, 6) to determine which mites are present and to estimate their relative abundance (Table 4).

All data will be recorded on 80-column data sheets, each of the 10 samples per tree being recorded on a separate sheet. Tables 1 and 2 depict the data sheets for pair sample 3. In addition, Tables 3, 4, and 5 will be used to record mite relative abundance and mortality as well as relative humidity and temperature data for each of the four trees. Thus, there will be 13 sheets for each tree with a grand total of 62 sheets for the four trees used in the study during CY 1980.

PRESENTATION OF RESULTS

One or more published papers will be submitted as the final report for this study.

PERSONNEL ASSIGNMENT

John C. Moser	Research Entomologist
Lawrence M. Roton	Biological Laboratory Technician
John W. Monahan	Biological Laboratory Technician

DATA ANALYSIS AND INTERPRETATION

There is one response variable each for the percent of brood beetles that have no mites of species 1, 2, 3, etc. and one response variable for the percent of brood beetles that have no mites at all.

There will be 2 treatments (Tables 1 and 2) with 5 paired replications (Fig. 1) for each of the 4 seasons in 1980, as follows:

	df
Season	3
Pairs/season	16
Treatment	1
Error	19
Total	39

LITERATURE CITED

Kinn, D. N. 1967. Note of the life cycle and habits of *Digamasellus quadrisetus* (Mesostigmata:Digamasellidae) Ann. Entomol. Soc. Am. 60:862-865.

Kinn, D. N. 1976. Key to mites commonly associated with the southern pine beetle. Southern Forest Experiment Station Research Note 214:1-11.

Kinn, D. N. 1979. Three methods of sampling mites phoretic on bark beetles: a comparison. Can. Entomol. 111:491-494.

Kinn, D. N. and J. J. Witcosky. 1977. The life cycle and behavior of *Macrocheles boudreauxi* Krantz. Z. ang. Entomol. 84:136-144.

McClelland, W. T., F. P. Hain, and W. D. Mawby. 1979. Comparison of within-tree distributions and population estimation procedures for declining populations of *Dendroctonus frontalis* colonizing loblolly and shortleaf pine. Environ. Entomol. 8:1037-1040.

Moser, J. C. 1975. Mite predators of the southern pine beetle. Ann. Entomol. Soc. Am. 68:1113-1116.

Moser, J. C. 1976. Surveying mites (Acarina) phoretic on the southern pine beetle (Coleoptera:Scolytidae) with sticky traps. Can. Entomol. 108:809-813.

Moser, J. C. and L. M. Roton. 1971. Mites associated with the southern pine beetle in Allen Parish, Louisiana. Can. Entomol. 103:1775-1798.

Roton, L. M. 1978. Mites phoretic on the southern pine beetle: when and where they attach. Can. Entomol. 110:557-558.

FIGURE AND TABLE CAPTIONS

Fig. 1. Generalized tree showing areas sampled.

Table 1. Removed bark: Phloem moisture reading and mite fauna of emerging SPB. (Card 1)

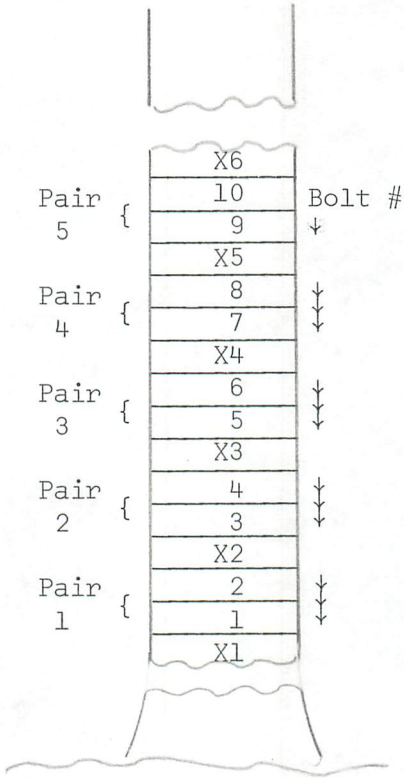
Table 2. Intact bark: Phloem moisture reading and mite fauna of emerging SPB. (Card 1)

Table 3. Temporal mortality of mite fauna on exposed inner bark (Bolt X3). (Card 2)

Table 4. Mite survey of inner bark soon after cutting. (Card 3)

Table 5. Temperature and relative humidity of work area at 12:00 noon. (Card 4)

Fig. 1.



See text for explanation of terms.

DATA LISTING FOR 80 COL. PUNCHED CARD

SOUTHERN FOREST EXPERIMENT STATION T-10210 FEDERAL BUILDING 701 LOYOLA AVENUE NEW ORLEANS, LOUISIANA 70113	STUDY	ENTERED BY	DATE	PUNCHED BY	DATE	PURCHASE ORDER	JOB No.	SHEET No.
	RESEARCHER	CHECKED BY	DATE	VERIFIED BY	DATE			___OF___

LINE NUMBER	FIELD DESIGNATIONS: Card number (1)	Tree # (2)	Season (3)	Pair # (4)	Treatment (5)	Phloem Moisture (6)	Emerging Date: Da (7-8)	Mo (9-10)	Yr (11-12)	Number SPB emerged without mites (13-15)	Number SPB emerged with mites (16-17)	Mite species Code (18)	Number SPB found on (19-20)	Mite species Code (21)	Number SPB found on (22-23)	Mite species Code (24)	Number SPB found on (25-26)	Mite species Code (27)	Number SPB found on (28-29)	Mite species Code (30)	Number SPB found on (31-32)	Mite species Code (33)	Number SPB found on (34-35)	Mite species Code (36)	Number SPB found on (37-38)	Mite species Code (39)	Number SPB found on (40-42)	Twr (43-80)
1	1	1	1	3	1	4	5	2	8	2	8	0	3	2	2	2	3	1	5	1								
2						2	5	2	9	2			7	6	1	1	2	3	3	1	5		2					
3						1	9		1	3			1	0	0	0	0											
4						1	6		2				2	3														
5						1	2		3				3	6														
6						1	1		4				3	5														
7						1	0		5				3	6														
8							8		6				2	8														
9							7		7				4	3														
10									8				8	3														
11									9				7	6														
12							1	0					4	7														
13							1	1					1	8														
14							1	2					1	8														
15							1	3						9														
16							1	4						6														
17	↓	↓	↓	↓	↓		↓	1	7	↓	↓		3	↓	↓	↓												
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Treatment

1. Bark removed from bolt
2. Bark left on bolt

Pair

1 to 5
up the tree

Mite Species Code

1. *Tarsonemus krantzi*
2. *Tarsonemus ips*
3. *Dendrolaelaps neodisetus*
4. *Trichouropoda australis*
5. *Histiogaster arborsignis*
6. *Proctolaelaps dendroctoni*
7. *Ereynetoides scutulis*

DATA LISTING FOR 80 COL. PUNCHED CARD

SOUTHERN FOREST EXPERIMENT STATION T-10210 FEDERAL BUILDING 701 LOYOLA AVENUE NEW ORLEANS, LOUISIANA 70113	STUDY	ENTERED BY	DATE	PUNCHED BY	DATE	PURCHASE ORDER	JOB No.	SHEET No.
	RESEARCHER	CHECKED BY	DATE	VERIFIED BY	DATE			OF

FIELD DESIGNATIONS

LINE NUMBER	Card number	Tree #	Season	Pair #	Treatment	Phloem Moisture	Emerging Date Da	Mo	Yr	Number of SPB emerged without mites	Number of SPB emerged with Mites	Mite species Code	Number SPB found on	Mite species Code	Number SPB found on	Mite species Code	Number SPB found on	Mite species Code	Number SPB found on	Mite species Code	Number SPB found on	Mite species Code	Number SPB found on	Mite species Code	Number SPB found on	Mite species Code	Number SPB found on	Mite species Code	Number SPB found on	Mite species Code	Number SPB found on
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2						4 0	2 9		2		2		1	1		1	2		1	3		1								
3							1		3			4	1		4	2		4	3		3	5		2						
4							2				1 4	1		1 1	2		1 3	3	1	3	5		4						
5							3				5	1		3	2		3	3		4									
6							4				1 1	1		8	2		9	3		9	4		2	5		3			
7							5			1	8	1		6	2		8	3		8	4		3	5		1			
8							6				1 1	1		3	2		1 1	3		9	4		4	5		1			
9							7			2	3 3	1		1 7	2		2 8	3	2	4	4		7	5		6	7		1
10							8				4 5	1		2 2	2		4 1	3	1	3	4	1	2	5	1	3			
11							9			2	3 1	1		2 1	2		1 7	3	1	0	4		6	5		7			
12							1 0				1 6	1		7	2		1 2	3		9	4		2	5		6			
13							1 1				1 5	1		6	2		1 4	3		6	4		7	5		3	7		1
14							1 2				8	1		3	2		7	3		7	4		6	5		2	7		1
15							1 3				1 7	1		6	2		1 6	3		5	4	1	0			6	7		1
16						3 5	1 4				3	1		3	2		3	4		1	5		3	5					
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Treatment

1. Bark removed from bolt
2. Bark left on bolt

Pair

1 to 5
up the tree

Mite Species Code

1. *Tarsonemus krantzi*
2. *Tarsonemus ips*
3. *Dendrolaelaps neodisetus*
5. *Histiogaster arborsignis*
6. *Proctolaelaps dendroctoni*
7. *Ereynetoides scutulis*

DATA LISTING FOR 80 COL. PUNCHED CARD

SOUTHERN FOREST EXPERIMENT STATION T-10210 FEDERAL BUILDING 701 LOYOLA AVENUE NEW ORLEANS, LOUISIANA 70113	STUDY	ENTERED BY	DATE	PUNCHED BY	DATE	PURCHASE ORDER	JOB No.	SHEET No.
	RESEARCHER	CHECKED BY	DATE	VERIFIED BY	DATE			___OF ___

FIELD DESIGNATIONS

LINE NUMBER	Card number	Season	Date Da	Date Mo	Date Yr	Number of hr. bark removed from bolt	Inner bark moisture reading	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.
1	2	1	1	4	8	0	1	7	5	1	3	2	3	3	3	4	2	5	3	6	2	7	3
2							2	7	0	1	3	2	3	3	3	4	2	5	3	6	2	7	3
3							3	6	1	1	3	2	3	3	3	4	2	5	3	6	2	7	3
4							4	5	0	1	2	2	2	3	2	4	2	5	2	7	2		
5							5	4	0	1	2	2	2	3	2	5	2	7	2				
6			↓				6	3	0	1	1	2	1	3	1	5	1	7	1				
7			2			1	2	2	0	1	1	2	1	5	1	7	1						
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Relative Abundance

1. Rare
2. Infrequent
3. Common

Mite Species

1. *Tarsonemus krantzi*
2. *Tarsonemus ips*
3. *Dendrolaelaps neodisetus*
4. *Trichouropoda australis*
5. *Histiogaster arborsignis*
6. *Proctolaelaps dendroctoni*
7. *Ereynetoides scutulis*

DATA LISTING FOR 80 COL. PUNCHED CARD

SOUTHERN FOREST EXPERIMENT STATION T-10210 FEDERAL BUILDING 701 LOYOLA AVENUE NEW ORLEANS, LOUISIANA 70113	STUDY	ENTERED BY	DATE	PUNCHED BY	DATE	PURCHASE ORDER	JOB No.	SHEET No.
	RESEARCHER	CHECKED BY	DATE	VERIFIED BY	DATE			___OF ___

Twp

LINE NUMBER	Card number	Tree number	Season	Date Da	Date Mo	Date Yr	Location sampled	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.	Mite species	Rel. abund.
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2							2	1	3		2 3		3 3		4 2		5 3		6 2		8 3									
3							3	1	3		2 3		3 2		4 2		5 3		6 1		8 3		9 1							
4							4	1	3		2 3		3 2		4 2		5 3		6 1		7 1		8 3							
5							5	1	3		2 2		3 2		4 2		5 2		8 3		9 1									
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Location Sampled (see Fig. 1)

X1 - Below pair 1
X2 - Between pairs 1 & 2
X3 - Between pairs 2 & 3

Relative Abundance

1. Rare
2. Infrequent
3. Common
4. Abundant

Mite Species

1. *Tarsonemus krantzi*
2. *Tarsonemus ips*
3. *Dendrolaelaps neodisetus*
4. *Trichouropoda australis*
6. *Proctolaelaps dendroctoni*
7. *Ereynetoides scutulis*
8. *Ereynetoides scutulis*
9. *Macrocheles boudreauxi*

:0-4000-4 Table 5.

DATA LISTING FOR 80 COL. PUNCHED CARD

SOUTHERN FOREST EXPERIMENT STATION T-10210 FEDERAL BUILDING 701 LOYOLA AVENUE NEW ORLEANS, LOUISIANA 70113	STUDY	ENTERED BY	DATE	PUNCHED BY	DATE	PURCHASE ORDER	JOB No.	SHEET No.
	RESEARCHER	CHECKED BY	DATE	VERIFIED BY	DATE			OF

Two

| LINE NUMBER | FIELD DESIGNATIONS | | |

SO-4000-5 (REV. 9/75)

BIOMETRICS REVIEW ROUTING

9/10/80

ROUTING

~~1. AD-W~~
~~2. Biometrics~~
3. RWU 2203

RESEARCH WORK UNIT

☒ STUDY PLAN ☐ MANUSCRIPT ☐ RESPONSE TO BIOMETRICS REVIEW ☐ _____ (OTHER)

FS-SO-2203-1.45 (STUDY NUMBER)

TEST OF A TECHNIQUE FOR REARING MITE-FREE SOUTHERN PINE BEETLE ADULTS (TITLE)

John C. Moser (AUTHOR SIGNATURE) Sept. 3, 1980 (DATE)

REMARKS:

SUBMITTED: Peter P. Lucio, Jr. (PROJECT LEADER SIGNATURE) Sept. 3, 1980 (DATE)

AD

☒ FORWARDED FOR BIOMETRICS REVIEW ☐ BIOMETRICS REVIEW WAIVED

Stanley J. Barras (ASSISTANT DIRECTOR SIGNATURE) 9/5/80 (DATE)

BIOMETRICS SERVICES

☐ NO COMMENTS ☐ COMMENTS BELOW ☐ COMMENTS ATTACHED
☒ COMMENTS MADE BY PHONE ☒ COMMENTS WRITTEN ON REVIEW DRAFT

T.R. Dell (BIOMETRICIAN SIGNATURE) (DATE)

IN 5 SEP 80

OUT 8 SEP 80

COMMENTS:

INSTRUCTIONS

1. Project Leader must submit this form with each study plan. Also use this form when manuscripts are submitted for review.
2. Insert desired "Routing" in space at top of form.
3. Be sure to insert proper identification in the "Research Work Unit" block.
4. Completed copies of this form will be filed in the study file in the Assistant Director's and Project Leader's files.

ORIGINAL – RESEARCH WORK UNIT FILE

U.S. DEPARTMENT OF AGRICULTURE **SPEED-MEMO**

PART NUMBER **3**

DATE Sept. 3, 1980

TO
Biometrics
ATTN: T. Dell

SUBJECT
4500

FROM
RWU 2203
Alexandria, LA

MESSAGE

I understand this study (FS-SO-2203-1.45 by Moser) has already gone through the Biometrics review, but for file we need an official biometrics review routing.

Thanks.

SIGNATURE Bettie Mallard

REPLY

SIGNATURE

DATE

(DESTROY THIS PART 3 UPON RECEIPT OF REPLY)

FORM AD-311 (REV. 5-68)